IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appl. No.   : 10/038,916
Applicant   : Ming Jia, et al.
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Examiner   : Qutbuddin Ghulamali

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Commissioner for Patents
Alexandria, VA 22313-1450
U.S.A.

Dear Sir:

APPEAL BRIEF UNDER 37 C.F.R. 41.37

The following is the Appellant's Brief, submitted under the provisions of 37 C.F.R. 41.37. The fee of $540 that is required by 37 C.F.R. 41.20(b)(2) for filing a brief in support of the Notice of Appeal is enclosed.

Real Party in Interest

The real party in interest is the assignee of record, i.e. Nortel Networks Limited, current address 2351 Boulevard Alfred-Nobel, St. Laurent, Quebec, Canada, H4S 2A9.

Related Appeals and Interferences

There are no related appeals or interferences that will directly affect, be directly affected by, or have a bearing on the present appeal.

Status of Claims

Claims 1-16, 18-32, 34-38, 40 and 41 are currently pending in the application. Claims 17, 33 and 39 have been cancelled.

The status of the claims based on the Final Office Action issued on May 29, 2008 is as follows:

Claims 1-16, 36, 40 and 41 are rejected for reasons identified below in the "Grounds of Rejection to be Reviewed on Appeal" section.

Claims 18-32, 34 and 35 are allowed.

Claims 37 and 38 are objected to, but allowable if rewritten in independent form, including the limitations of base claim 36.

The claims being appealed are claims 1-16, 36, 40 and 41.

Status of Amendments

No amendments have been made subsequent to the Final Office Action.

Summary of Claimed Subject Matter

The invention as recited in independent claim 1 relates to "A channel quality measurement apparatus adapted to measure a quality of a channel over which has been transmitted a sequence of symbols produced by encoding and constellation mapping a source data element sequence". An example of a channel quality apparatus adapted to measure a quality of a channel over which has been transmitted a sequence of symbols produced by encoding and constellation mapping a source data element sequence is illustrated as reference character 230 in Figure 2. An example of such an apparatus is described in detail starting at page 18, line 25.

In claim 1, the apparatus is recited to include "a symbol de-mapper, receiving as input a sequence of received symbols over the channel whose quality is to be measured, said symbol

de-mapper being adapted to perform symbol de-mapping on said sequence of received symbols to produce a sequence of soft data element decisions". An example of such a de-mapper is described with respect to Figure 2 at page 18, line 29 to page 19, line 3. In Figure 2, the de-mapper is identified by reference character 236.

In claim 1, the transmitter is recited to also include "a soft decoder, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, said soft decoder being adapted to decode the sequence of soft data element decisions to produce a decoded output sequence". An example of a soft decoder is described with respect to Figure 2 at page 19, lines 3-7. In Figure 2, the soft decoder is identified by reference character 238.

In claim 1, the transmitter is recited to also include "an encoder, receiving as input the decoded output sequence produced by the soft decoder, said encoder being adapted to re-encode the decoded output sequence with an identical code to a code used in encoding the source data element sequence to produce a re-encoded output sequence". An example of an encoder is described with respect to Figure 2 at page 19, lines 7-9 and lines 12-16. In Figure 2, the encoder is identified by reference character 240.

In claim 1, it is further recited that "a correlator, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, and the re-encoded output sequence produced by the encoder, said correlator being adapted to produce a channel quality indicator output by determining a correlation between the sequence of soft data element decisions and the re-encoded output sequence". An example of a correlator is described with respect to Figure 2 at page 19, lines 13-16 and lines 20-32. In Figure 2, the correlator is identified by reference character 250.

In claim 1, it is further recited that "wherein the apparatus is adapted to feed the channel quality indicator back to a transmitter for use in determining and applying an appropriate coding rate and modulation to the source data element sequence". The limitation of feeding back the quality indicator back to the transmitter is described for example at page 24, lines 15-20.

The invention as recited in independent claim 4 relates to "A method of measuring channel quality of a channel over which has been transmitted a sequence of symbols produced by

encoding and constellation mapping a source data element sequence". The method described in claim 4 substantially corresponds to functionality performed by the elements of the apparatus of claim 1, which is described starting at page 18, line 25.

The method of claim 4 recites a step of "receiving a sequence of received symbols over the channel whose quality is to be measured". As claim 4 is a method of measuring channel quality of a channel over which has been transmitted a sequence of symbols, claim 4 is a method performed at the receiving end of the transmission. Therefore, a first step of the method is receiving the symbols over the channel. For example, the receiver front-end 234 in Figure 2 is an example of an element that may perform the receiving, together with antenna 232, as described at page 18, lines 25-29.

The method of claim 4 recites a further step of "symbol de-mapping said sequence of received symbols to produce a sequence of soft data element decisions". This method step corresponds to a function performed by the symbol de-mapper 236 of the mobile station 230 in Figure 2, which is described at page 18, line 29 to page 19, line 3.

The method of claim 4 recites a further step of "decoding said sequence of soft data element decisions to produce a decoded output sequence". This method step corresponds to a function performed by the soft decoder 238 of the mobile station 230 in Figure 2, which is described at page 19, lines 3-7.

The method of claim 4 recites a further step of "re-encoding said decoded output sequence to produce a re-encoded output sequence using a code identical to a code used in encoding the source data element sequence". This method step corresponds to a function performed by the encoder 240 of the mobile station 230 in Figure 2, which is described at page 19, lines 13-17.

The method of claim 4 recites a further step of "correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output". This method step corresponds to a function performed by the correlator 250 of the mobile station 230 in Figure 2, which is described at page 19, lines 20-32.

Independent method claim 7 is directed to similar subject matter to that of independent method claim 4, with the additional limitation that it is an OFDM channel quality being measured of an OFDM channel over which has been transmitted a sequence of OFDM symbols. An example of an embodiment of the invention being performed for OFDM can be found in the specification at page 17, lines 16-17, in which it is described that "The preferred embodiment presented is based on an MIMO-OFDM frame structure". An OFDM frame deals with OFDM symbols, channels and channel quality. The steps of symbol demapping, decoding, re-encoding and correlating are described at page 18, line 25 to page 19, line 32, as discussed in detail above with reference to claim 4.

Independent system claim 11 is directed to a communication system comprising a transmitter and a receiver. An example of such a system is described in the present application from page 17, line 26 to page 19, line 31 with respect to Figure 2. The transmitter of claim 11 is recited to be "a transmitter adapted to transmit a sequence of symbols produced by encoding and constellation mapping a source data element sequence over a channel". An example of such a transmitter is described at page 17, line 26 to page 18, line 17 and is identified in particular by reference character 210. Reference characters 200 and 220 are examples of additional transmitters in Figure 2. The claim recites a receiver comprising a collection of elements similar to the elements of independent apparatus claim 1. Examples of these elements a symbol de-mapper, a soft decoder, an encoder, and a correlator are described at page 18, line 25 to page 19, line 32. As described above, an example of the receiver is identified as reference character 230.

Independent method claim 14 is directed to "A method of adaptive modulation and coding". The method is for adaptive modulation and coding since information received at the receiver is fed back to the transmitter to adaptively influence the modulation and coding of the transmitter (page 5, lines19-21 and page 24, lines14-15). The method includes a first step of "transmitting over a channel a sequence of symbols produced by encoding and constellation mapping a source data element sequence". This is described in the present application, for example, at page 18, lines 12-14. The steps of "receiving a sequence of received symbols over the channel; symbol de-mapping said sequence of received symbols to produce a sequence of soft data element decisions; decoding said sequence of soft data element decisions to produce a decoded output sequence; re-encoding said decoded output sequence to produce a re-encoded

output sequence using a code identical to a code used in encoding the source data element sequence; correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output" are substantially the same steps as recited in independent claims 4 and 7 and as such are described at page 18, line 25 to page 19, line 32.

A further step of the method includes "transmitting the channel quality indicator". An example of this step is described at page 24, lines 15-17.

Another step of the method is "using said channel quality indicator to determine and apply an appropriate coding rate and modulation to the source data element sequence". An example of this step is described at page 24, lines 17-20.

Independent claim 36 is directed to "A method of determining a channel response from an Orthogonal Frequency Division Multiplexing (OFDM) frame received at an OFDM receiver, the OFDM frame containing an encoded fast signalling message in the form of encoded symbols within the OFDM frame". Determining a channel response from an Orthogonal Frequency Division Multiplexing (OFDM) frame received at an OFDM receiver, the OFDM frame containing an encoded fast signalling message in the form of encoded symbols within the OFDM frame is described in the present application at page 25, lines 23-27 and page 26, lines 16-19.

Claim 36 further recites the step of "processing the encoded symbols based on a scattered pilot pattern to recover the encoded fast signalling message as a recovered fast signalling message". The step of "processing the encoded symbols" may include, for example, one or more of steps one to four as described at page 25, line 28 to page 26, line 9.

Claim 36 further recites the step of "re-encoding the recovered fast signalling message so as to produce known pilot symbols in the scattered pilot pattern". The step of "re-encoding the fast signalling" may include, for example, one or both of steps five and six as described at page 26, lines 9-12.

Claim 36 further recites the step of "determining a channel response for the encoded symbols using decision feedback". The step of "determining a channel response for the encoded

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symbols" may include, for example, one or both of steps seven and eight as described at page 26, lines 16-19. An example of the expression "decision feedback" is located at page 37, lines 11-15. Specifically, this example refers to the function of re-encoding the decoded data after the transmit parameter signalling symbols have been decoded.

Independent claim 40 is directed to "A transmitter adapted to combine pilot and transmission parameter signalling on a single overhead channel within an OFDM signal". Combining pilot and transmission parameter signal on an overhead channel within an OFDM signal is described in the present application at page 25, line 23 to page 26, line 15.

Claim 40 further recites "an encoder" and "at least one transmit antenna". Examples of these limitations are illustrated in Figure 2 in block 240 and antenna 232, respectively, and in the corresponding description at page 18, line s 25-27 and page 19, lines 7-17.

Claim 40 further recites "wherein a set of transmission parameter signalling symbols are transmitted by the at least one transmit antenna on the overhead channel with strong encoding performed by the encoder such that at a receiver, they can be decoded accurately, re-encoded, and the re-encoded symbols treated as known pilot symbols which can then be used for channel estimation". The functionality of decoding and re-encoding in particular, substantially corresponds to similar functionality of decoding and re-encoding recited in claims 1 and 4 and discussed in detail above with reference to claims 1 and 4. The re-encoded symbols being treated as known pilot symbols used for channel estimation is described for example at page 37, line 9 to page 38, line 6.

Grounds of Rejection to be Reviewed on Appeal

The issues which are hereby presented for review are as follows:

1.   whether claims 1, 4, 7, 11 and 14 are unpatentable under 35 U.S.C. 103(a) over ten Brink (US Patent 6,611,513) in view of Stein (USP 6,175,590) and Lucas (USP 5,488,600) and further in view of Balachandran et al. (USP 6,215,827, hereinafter Balachandran);

2.   whether claims 2, 3, 5, 6, 12, 13, 15 and 16 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas and Balachandran and further in view of Jones et al. (USP 6,215,813, hereinafter Jones);

3.   whether claims 8 to 10 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas, Balachandran and further in view of Thomas et al. (United States Patent Publication No. 2002/0051498, hereinafter Thomas);

4.   whether claim 36 is unpatentable under 35 U.S.C. 103(a) over Agee et al. (USP 6,621,851, hereinafter Agee) in view of Tiedemann, Jr. et al. (US Publication 2006/0094460, hereinafter Tiedemann); and

5.   whether claims 40 and 41 are anticipated under 35 U.S.C. 102(e) by Walton et al. (US publication 2006/0105761, hereinafter Walton).

Argument

1.   Whether claims 1, 4, 7, 11 and 14 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein and Lucas and further in view of Balachandran.

In rejecting claims under 35 U.S.C. § 103(a), the Examiner bears the initial burden of establishing a prima facie case of obviousness. *In re Oetiker*, 977 F.2d 1443, 1445 (Fed. Cir. 1992). *See also In re Piasecki*, 745 F.2d 1468, 1472 (Fed. Cir. 1984). It is incumbent upon the Examiner to establish a factual basis to support the legal conclusion of obviousness. *See In re Fine*, 837 F.2d, 1071, 1073 (Fed. Cir. 1988). In so doing, the Examiner is expected to make the factual determinations set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 17 (1966), *viz.*, (1) the scope and content of the prior art; (2) the differences between the prior art and the claims at issue; and (3) the level of ordinary skill in the art. Additionally, in making a rejection under 35 U.S.C. § 103(a) on the basis of obviousness, the Examiner must provide some articulated reasoning with some rational underpinning to support the legal conclusion of obviousness. *KSR Int'l. Co. v. Teleflex Inc.*,127 S.Ct. 1727, 1741 (2007). Only if this initial burden is met does the burden of coming forward with evidence or argument shift to the appellant. *See Oetiker*, 977 F.2d at 1445. *See also Piasecki*, 745 F.2d at 1472. Obviousness is then determined on the basis

of the evidence as a whole and the relative persuasiveness of the arguments. *See Oetiker*, 977 F.2d at 1445; *Piasecki*, 745 F.2d at 1472.

Applicant's analysis below demonstrates that the Examiner has failed to fulfil the initial burden for a finding of obviousness under 35 U.S.C. 103.

Applicant submits that claims 1, 4, 7, 11 and 14 of the present application are patentable over ten Brink in view of Stein and Lucas and further in view of Balachandran, as the Examiner has not properly determined the differences between the claimed invention and the prior art. Furthermore, the Examiner has not provided a valid explanation to support an obviousness rejection under 35 U.S.C. 103. Applicant's reasoning is detailed below.

Differences between the claimed invention and the prior art

In paragraph 5 of the Final Office Action issued May 29, 2008, the Examiner has rejected claims 1 and 11 under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein and Lucas and further in view of Balachandran.

Claim 1

The Examiner has alleged that the limitation of "a correlator adapted to produce a channel quality indicator" recited in claim 1 is disclosed in Figure 1 of newly cited reference Lucas in the form of elements 10, 20 and 30 and at col. 5 lines 15-27 and 33-35.

Lucas discloses a "method for selecting multiple propagation paths retained for receiving messages transmitted in a CDMA radio communication system, each path being identified by a delay which is applied to at least one spreading sequence for determining a correlation between the received signal and said spreading sequence" (column 2, lines 61-67).

Lucas discloses a rake receiver having two data reception arms 10,20 and a search arm 30. The search arm has a single correlator, indicated by reference character 33 in Figure 1, in which a received signal is correlated with a delayed version of a pilot spreading code C_p known to be used in the received signal. If a correlation output of the received signal with a delayed version of a pilot spreading code C_p is greater than "at least one of the reception energies E1, E2 associated to the previously selected delays D1, D2, the management unit 40 substitutes the

delay D for the previously selected delay D1 or D2 for which the reception energy is the lowest. This ensures that the delays allocated to the reception arms 10, 20 correspond to the paths for which the propagation conditions are the best" (col. 5, lines 49-57 of Lucas).

The output of correlator 33 is disclosed to represent "an estimation of the channel response along the tested path" (col. 5, lines 43-44). However, Applicant submits that an estimation of a channel response in the manner it is disclosed in Lucas does not correspond to "a channel quality indicator" as recited in the present claims. As indicated on page 17 of the present application, a "Channel Quality Indicator" (CQI) provides an overall assessment of the quality of the channel, including the effects of interference, multi-path fading, and Doppler spread. Applicant submits that the correlation of a received signal with a spreading code known to be used in the received signal that is delayed by an estimated delay value, as disclosed in Lucas, provides an assessment of the delay of the received signal, i.e. the accuracy of the estimated delay applied to the spreading code compared to the amount of actual delay incurred by the received signal. This may allow for better delay estimates to be made for a given channel and improve the probability of receiving a signal. As stated at col. 5, lines 55-57 of Lucas, "This ensures that the delays allocated to the reception arms 10, 20 correspond to the paths for which the propagation conditions are the best". However, it does not provide an indication of the quality of the channel. Applicant submits that a high correlation value is indicative of an appropriate selection of estimated delay value D applied to pseudorandom generator 31 (as indicated in Figure 1) with respect to the received signal. Therefore, Applicant submits that a high correlation value output from correlator 33 is an indication of appropriate selection of the delay value with respect to the received signal, and not as an indication of the overall quality of the channel. The size of a delay incurred by the channel, whether large or small, may not have a direct correlation to the overall channel quality. For example, a channel with a small delay may still have a poor channel quality related to other factors and a channel with a large delay may have a high quality channel, despite a large delay. In summary, while Lucas may disclose an estimate of a channel response for a given path, there is no indication that this is equivalent to "a channel quality indicator" as recited in claim 1.

Furthermore, Lucas does not disclose that the correlator is adapted to produce a channel quality indicator "by determining a correlation between the sequence of soft data element

decisions and the re-encoded output sequence". Lucas is correlating a reference spreading sequence C_p with a delay D allocated by management unit 40. Therefore, Lucas is not correlating a re-encoded output sequence in the manner recited in claim 1.

The Examiner further states that the combination of ten Brink, Stein and Lucas do not disclose "wherein the apparatus is adapted to feed the channel quality indicator back to a transmitter for use in determining and applying an appropriate coding rate and modulation to the source data element sequence". It is alleged that Balachandran teaches this limitation at column 13 line 65 to column 14 line 44. Applicant submits that while Balachandran may disclose feeding back SIR information from a receiver to transmitter for changing coded modulation, Applicant submits that feeding back SIR information from a receiver to a transmitter is not the same as feeding back a correlation output from correlator 33 as disclosed in Lucas. The output of correlator 33 is merely used to determine whether the selected delay along the tested path is an improved selection from that already being used by one of the data reception arms. Applicant submits that there is no suggestion in Lucas that the correlation output, which the Examiner equates with the "channel quality indicator" recited in claim 1, could be useful for changing the coded modulation in a transmitter as the Examiner alleges is disclosed in Balachandran. Therefore, Applicant submits that merely transmitting the correlator output of Lucas in the manner disclosed by Balachandran, would not result in the claimed invention. Furthermore, Applicant submits that the Examiner has not established that one skilled in the art would be capable of combining the different types of subject matter of Balachandran and Lucas in a manner that would operate in the manner claimed.

Even though it may appear that each of the four cited references disclose particular limitations of claim 1, Applicant submits that the Examiner has not established that the specific subject matter of each of the references can be combined in a manner that would result in the claimed invention. As such, there are differences between the claimed subject matter and the combination of the prior art that result in all of the limitations of claim 1 not being disclosed in the subject manner.

For at least the reasons discussed above, Applicant respectfully submits that the combination of ten Brink, Stein, Lucas and Balachandran et al. do not teach all the limitations

recited in amended claim 1. Furthermore, the Examiner has failed to explain why missing limitations would be obvious to one skilled in the art. Without all the limitations of claim 1 being disclosed by the two references and no reason provided by the Examiner why these missing limitations would be obvious, it is not reasonable to expect one skilled in the art to arrive at the claimed invention based on the combination of the cited references.

Reason to Combine

Once the scope of the prior art is ascertained, the content of the prior art must be properly combined. An obviousness inquiry requires review of a number of factors, including the background knowledge possessed by a person having ordinary skill in the art, to determine whether there was an apparent reason to combine the elements of the prior art in the fashion claimed by the present invention. For the Patent Office to combine references in support of an obviousness rejection, the Patent Office must identify a reason why a person of ordinary skill in the art would have combined the references *KSR Int'l v. Teleflex, Inc., No. 04-1350, slip op. at 14 (U.S., Apr. 30, 2007)*, Id. at 15. Even if the Patent Office is able to articulate and support a suggestion to combine the references, it is impermissible to pick and choose elements from the prior art while using the application as a template.

Applicant submits that there is no suggestion of a desirability of the claimed invention in any of the references that would serve as a reason for one skilled in the art to combine the collection of references identified by the Examiner. On the contrary, Applicant submits that there are several reasons that the references would not be considered suitable for combining, as will be discussed in detail below.

Claim 1 is directed to "A channel quality measurement apparatus adapted to measure a quality of a channel over which has been transmitted a sequence of symbols produced by encoding and constellation mapping a source data element sequence".

To begin, Applicant submits that when considered individually none of ten Brink, Stein or Lucas is directed to channel quality measurement. ten Brink is directed to iterative de-mapping of a received signal. There is no re-encoding of a decoded output sequence in the manner claimed, and there is no feeding back of any channel quality indicator, both of which are

conceded by the Examiner on pages 5 and 6 of the Final Office Action. Stein is directed to determining the rate of received data in a variable rate communication system. While Stein does decode a signal, re-encode it, and compare it to the originally received signal, there is no indication that the correlation is used to determine a channel quality measurement or feeding back a channel quality indicator to a transmitter. Lucas performs correlation to determine if an estimate of delay for a given path is better than other estimates being used in decoding the received signal, but there is no indication that the correlation output is being used as a channel quality indicator, especially one that would be fedback to a transmitter. While the Examiner states on page 4 of the Final Office Action that "one cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references", Applicant submits that pointing out that none of the references provide a suitable reason for combining the references is necessary to show that without a proper reason to combine, one skilled in the art would not be expected to arrive at the claimed invention.

The Examiner has cited four references, each of which allegedly disclose specific limitations of the claimed invention, but at least three of the four are not directed to subject matter related to the claimed invention. Applicant submits that while the references individually may appear in isolation to teach individual limitations of the claims, there is no reasoning provided that would result in one skilled in the art selecting only these particular elements from the references and combining them in the manner of the claimed invention. Applicant submits that the elements from the various references are being picked and chosen while using the application as a template, which the Applicant reminds the Examiner is not permissible.

Applicant submits that the necessity of having to combine four (and in some of the claim rejections up to five) separate documents suggests that one skilled in the art would be unlikely to combine the references, especially in view of the varied problems/applications that the cited references are directed toward.

Furthermore, with respect to Lucas, Applicant submits that the Examiner has taken the disclosure of the correlator and its intended use out of the context. As Lucas does not recite the correlator is adapted to produce a channel quality indicator "by determining a correlation between the sequence of soft data element decisions and the re-encoded output sequence", and as

there is no suggestion or disclosure of applying what is recited in Lucas in a manner recited in the present claims, Applicant submits that one skilled in the art would not consider the disclosure in Lucas in combination with the other cited references.

The Examiner's motivation for combining ten Brink, Stein and Lucas set out at the middle of page 7 with respect to the limitation of "a correlator adapted to produce a channel quality indicator" alleged to be disclosed by Lucas, are tied to his view that Lucas teaches this limitation. As detailed above, this is an incorrect interpretation of Lucas, and as such this also affects the Examiner's reasoning for combining the references.

Lucas is directed to using correlation to determine a potentially improved delay estimate for a given path to improve detection of a received signal at the receiver as opposed to the receiver providing feedback to a transmitter to alter the transmission characteristics at the transmitter. Applicant submits that using feedback to alter the transmission characteristics of a transmitted signal teaches away from the manner of trying to improve detection of a received signal by only trying to improve operation of the receiver, i.e. by optimizing the delay estimate. In the case of the cited references, Applicant submits that one skilled in the art would not consider combining references such as Lucas, which discloses improving detection of a received signal at the receiver, and Balachandran, which discloses altering characteristics of the transmitter, that teach away from one another.

The Examiner explains the alleged reason for combining ten Brink, Stein and Lucas with Balachandran at the bottom of page 7 and the top of page 8 of the current Office Action. It is alleged that Balachandran discloses transmitting a channel quality indication to a transmitter for use in determining and applying an appropriate coding rate and modulation. However, as described above, Lucas does not disclose determining a channel quality indicator. Thus, if one were to combine Lucas with ten Brink, Stein and Balachandran (assuming there would be any motivation for such a combination, which Applicant does not concede), it seems that a person skilled in the art would feedback a value that is a function of the correlator disclosed by Lucas to the transmitter. However, as the correlation value is related to the amount of delay experienced in a given channel, Applicant submits that it is unclear how the feedback would be used in determining and applying an appropriate coding rate and modulation. Combining Lucas with ten

Brink, Stein and Balachandran does not yield the claimed invention because of the missing step of using the correlation result as a channel quality indicator and feeding back the channel quality indicator to the transmitter for use in determining and applying an appropriate coding rate and modulation is not disclosed by the combination of references as claimed.

On the bottom of page 7 and top of page 8 of the Final Office Action, the Examiner states that it would have been obvious to combine ten Brink, Stein and Lucas with Balachandran because the channel quality determination feedback to the transmitter can allow efficient and accurate rate adjustment of the transmission of the coded communication data signal. As discussed above, Lucas does not disclose producing a channel quality indicator. Applicant submits without citing a reference operable to produce a channel quality indicator in a manner that is consistent with embodiments of the present invention, in particular as recited in independent claim 1, there is no reason to combine a further reference (for example Balachandran) that is alleged to disclose the limitation of transmitting a channel quality indicator to the transmitter for use in determining and applying an appropriate coding rate and modulation.

Furthermore, it is an objective of Stein to minimize overhead. See column 6, lines 47-54, where the reason for not signalling the rate used for transmission, thereby requiring blind rate detection in the receiver, is established as avoiding the requirement of additional overhead bits. Thus, the additional overhead required by the Balachandran approach of feeding back information to a transmitter would be something to be avoided in the system of Stein.

For at least the reasons set forth above, Applicant respectfully submits the Examiner has not provided a satisfactory reason why a person of ordinary skill in the art would have combined the references.

On this basis of the above, Applicant submits that the Examiner has failed to establish a *prima facie* case of obviousness and it is respectfully submitted that the Examiner has erred in rejecting claim 1 under 35 U.S.C. 103(a).

Claim 11

Independent claim 11 recites a system comprising a transmitter and a receiver that comprises the elements of the apparatus of claim 1. For at least the same reasons described above with regard to claim 1, Applicant submits that claim 11 patentably distinguishes over the

combination of references. On this basis, it is considered that the Examiner has erred in rejecting claim 11 under 35 U.S.C. 103(a).

Claims 4 and 7

In paragraph 7 of the Final Office Action, the Examiner has rejected independent claim 4, under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein, Lucas and Balachandran. In paragraph 9 of the Final Office Action, the Examiner has rejected independent claim 7 under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein, Lucas and Balachandran.

As described above in the Summary of Claimed Subject Matter section, claims 4 and 7 are substantially similar to one another with regard to their subject matter, except that claim 7 has the additional limitation that the method is directed to OFDM.

Claims 4 and 7 are similar to the subject matter recited in claims 1 and 11, except that they do not recite the additional limitation of feeding back the channel quality indicator back to a transmitter for use in determining and applying an appropriate coding rate and modulation to the source data element sequence. As such it is unclear why the Examiner has included Balachandran in the rejection of these claims.

For the same reasons described above with regard to claim 1, Applicant submits that Lucas does not teach the limitation of "correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output". In particular, Lucas does not teach producing "a channel quality indicator output".

For at least the reasons submitted above for claim 1 pertaining to the reason for combining at least ten Brink, Stein and Lucas, Applicant submits that the Examiner has failed to provided a satisfactory reason for combining the cited references in the rejection of claims 4 and 7.

Applicant submits that the Examiner has failed to satisfy the requirements of establishing a *prima facie* case of obviousness. On this basis it is considered that the Examiner has erred in rejecting claims 4 and 7 under 35 U.S.C. 103(a).

Claim 14

In paragraph 11 of the Final Office Action, the Examiner has rejected independent claim 14 under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein, Lucas and Balachandran.

Claim 14 is a method claim that recites steps performed both in a transmitter and a receiver. Claim 14 recites steps included in claim 4, but also includes an initial step of transmitting a sequence of symbols. Furthermore, claim 14 also includes the steps of "transmitting the channel quality indicator and using said channel quality indicator to determine and apply an appropriate coding rate and modulation to the source data element sequence", which are not recited in claim 4, but which are recited in claims 1 and 11. Therefore, the arguments presented above pertaining to claims 1 and 11 apply to claim 14.

For at least the above reasons, Applicant submits that the Examiner has failed to satisfy the requirements of establishing a *prima facie* case of obviousness, and as a result it is considered that the Examiner has erred in rejecting claim 14 under 35 U.S.C. 103(a).

2.   Whether claims 2, 3, 5, 6, 12, 13, 15 and 16 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas and Balachandran and further in view of Jones.

In paragraph 6 of the Final Office Action, the Examiner has rejected claims 2, 3, 12 and 13 on the basis of the same references as in claims 1 and 11, and further in view of Jones.

Claims 2 and 3 depend on claim 1 and claims 12 and 13 depend on claim 11. Applicant submits that Jones does not teach the missing limitations of claims 1 and 11 discussed above. For at least the reason of their dependence upon claims 1 and 11, Applicant respectfully submits that claims 2, 3, 12 and 13 should be patentable for at least the same reasons submitted above pertaining to claims 1 and 11.

On this basis it is considered that the Examiner has erred in rejecting claims 2, 3, 12 and 13 under 35 U.S.C. 103(a).

In paragraph 8 of the Final Office Action, the Examiner has rejected claims 5, 6, 15 and 16 under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein and further in view of Jones.

Claims 5 and 6 depend on claim 4 and claims 15 and 16 depend on claim 14. The arguments presented above pertaining to claim 4 likewise apply to claims 5 and 6. The arguments presented above pertaining to claim 1 likewise apply to claims 15 and 16, as claim 14 includes substantially similar subject matter to claim 1.

On this basis, it is considered that the Examiner has erred in rejecting claims 5, 6, 15 and 16 under 35 U.S.C. 103(a).

3.   Whether claims 8 to 10 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas, Balachandran and further in view of Thomas.

In paragraph 10 of the Final Office Action, the Examiner has rejected claims 8 to 10 under 35 U.S.C. 103(a) as being unpatentable over ten Brink in view of Stein, Lucas, Balachandran and further in view of Thomas.

Claims 8 to 10 depend on claim 7. Applicant submits that Thomas does not teach the limitations alleged to be disclosed by the combination of ten Brink, Stein, Lucas and Balachandran, but which are missing from the combination of ten Brink, Stein, Lucas and Balachandran for at least the reasons discussed above. Therefore, Applicant submits that the combination of ten Brink, Stein, Lucas, Balachandran and Thomas does not disclose all the limitations of at least claim 7, upon which claims 8 to 10 are dependent. For at least this reason, Applicant submits that claims 8 to 10 patentably distinguish over the combination of references.

Furthermore, Applicant submits that the Examiner has not provided a suitable reason for combining ten Brink, Stein, Lucas and Balachandran for at least the reasons submitted above. As such, Applicant submits that there is no suitable reason for further adding Thomas to the combination of the four cited references.

For at least the above reasons, it is considered that the Examiner has erred in rejecting claims 8 to 10 under 35 U.S.C. 103(a).

4.   Whether claim 36 is unpatentable under 35 U.S.C. 103(a) over Agee et al. (USP 6,621,851) in view of Tiedemann, Jr. et al. (US Publication 2006/0094460).

In paragraph 12 of the Final Office Action, the Examiner has rejected claim 36 under 35 U.S.C. 103(a) as being unpatentable over Agee and Tiedemann. The Examiner submits that Agee discloses "processing the encoded symbols based on a scattered pilot pattern to recover the encoded fast signalling message" at col. 7, lines 54-64, col. 17, lines 50-60, col. 23, lines 31-37 and col. 23, line 61 to col. 24, line 2. Applicant submits that the portions of Agee cited by the Examiner disclose generally how the discrete multitone stacked carrier scheme operates (col. 7, lines 54-64), how a channel estimate can be performed using a pilot signal (col. 17, lines 50-60), how to perform a frequency domain to time domain transformation (col. 23, lines 31-37) and how selected tones within a tone set are designated as pilots and are distributed throughout the frequency band (col. 23, lines 61 to col. 24, line 2). Applicant submits that Agee does not suggest or disclose an OFDM frame containing an "encoded fast signalling message" as recited in the preamble of claim 36 or the step of "processing the encoded symbols based on <u>a scattered pilot pattern to recover the encoded fast signalling message</u>" (emphasis added).

For at least the reason discussed above, Applicant respectfully submits that there are differences between what is recited in claim 36 and in the combination of Agee and Tiedemann.

On this basis it is considered that the Examiner has erred in rejecting claim 36 under 35 U.S.C. 103(a).

5.   Whether claims 40 and 41 are anticipated under 35 U.S.C. 102(e) by Walton.

Controlling case law has frequently addressed rejections under 35 U.S.C. § 102. "For a prior art reference to anticipate in terms of 35 U.S.C. Section 102, **every element** of the claimed invention **must** be **identically** shown in a single reference." <u>Diversitech Corp. v. Century Steps, Inc.</u>, 850 F.2d 675, 677, 7 U.S.P.Q.2d 1315, 1317 (Fed. Cir. 1988; emphasis added). The disclosed elements must be arranged as in the claim under review. <u>See Lindemann Machinefabrik v. American Hoist & Derrick Co.</u>, 730 F.2d 1452, 1458, 221 U.S.P.Q. 481, 485 (Fed. Cir. 1984). If any claim, element, or step is absent from the reference that is being relied

upon, there is **no** anticipation. <u>Kloster Speedsteel AB v. Crucible, Inc.,</u> 793 F.2d 1565, 230 U.S.P.Q. 81 (Fed. Cir. 1986; emphasis added). The following analysis of the present rejections is respectfully offered with guidance from the foregoing controlling case law decisions.

In paragraph 14 of the Final Office Action the Examiner has maintained the rejection of claims 40 and 41 as being anticipated by Walton.

The Examiner alleges on pages 20 and 21 that Walton discloses "wherein a set of transmission parameter signalling symbols are transmitted on the overhead channel (data channel) with strong encoding (increased reliability) such that at a receiver, they can be decoded accurately, re-encoded, and the re-encoded symbols treated as known pilot symbols which can then be used for channel estimation" at page 9, paragraph [0100] and [0101], page 10 paragraph [0103] and [0104] and page 11 paragraph [0112].

Applicant submits that the portions of Walton identified by the Examiner do not explicitly disclose that "a set of transmission parameter signalling symbols are transmitted by the at least one transmit antenna on the overhead channel such that at a receiver, they can be decoded accurately, <u>re-encoded,</u> and the re-encoded symbols treated as known pilot symbols which can then be used for channel estimation" (emphasis added). In paragraph [0104], Walton discloses that the "RX MIMO/data processor 556 performs processing complementary to that performed by TX data processor 514 and TX MIMO processor 520 and provides decoded data to a data sink 560". As there is no disclosure that TX data processor 514 and TX MIMO processor 520 encode and then decode the encoded signal, which would be the complementary processes of decoding the received signal and re-encoding the decoded signal, Applicant submits that not all of the limitations of claim 40 are identically disclosed by Walton.

The specified portions of Walton also do not explicitly disclose the "set of <u>transmission parameter signalling symbols</u> are transmitted by the at least one transmit antenna on the overhead channel". The Examiner equates the expression "overhead channel" of claim 40 to "data channel" as disclosed by Walton. Applicant submits that an overhead channel is a channel not used for data, but is a channel used for overhead/control signalling. In paragraph [0112], Walton discloses that "Pilot data (e.g., data of known pattern) may also be encoded and multiplexed with the processed information bits. The processed pilot data may be transmitted

(e.g., in a time division multiplexed (TDM) manner) in all or a subset of the transmission channels used to transmit the information bits". There is no indication that theses channels are overhead channels. Furthermore, the Examiner does not indicate that Walton discloses "transmission parameter signalling symbols" being transmitted in overhead channels.

Applicant submits that the Examiner has improperly characterized Walton. The limitations that are disclosed in Walton and are alleged to be equivalent to features of claim 40 are not the same or are missing altogether. As Walton does not identically show **every element** of the claimed invention, Applicant submits that Walton does not anticipate claim 40.

Claim 41 recites "A receiver adapted to process the combined single overhead channel produced by the transmitter of claim 40, the receiver comprising: at least one receive antenna; a soft decoder; an encoder; the receiver being adapted to: utilize the soft decoder to decode a received signal from the at least one receive antenna containing the encoded transmission parameter signalling symbols as modified by a channel; utilize the encoder to re-encode the decoded symbols to produce known pilot symbols; and compare received symbols with the known pilot symbols to produce a channel estimate" (emphasis added). The Examiner alleges that the limitations of claim 41 are disclosed in Walton at the same portions indicated in the rejection of claim 40.

For reasons similar to those submitted above in the response to the rejection of claim 40, Applicant submits that Walton does not disclose a receiver with "an encoder" for re-encoding decoded symbols to produce known pilot symbols or any suggestion of "encoded transmission parameter signalling symbols" on a "single overhead channel". Furthermore, Applicant submits that the identified portions of Walton make no disclosure of comparing received signals with known pilot symbols to produce a channel estimate, in the manner claimed.

As Walton does not identically show **every element** of the claimed invention, Applicant submits that Walton et al. does not anticipate claim 41.

On this basis it is considered that the Examiner has erred in rejecting claims 40 and 41 under 35 U.S.C. 102(e).

Response to the Response to Arguments Section on pages 2-4 of the Final Office Action

It is stated on page 2 of the Final Office Action that the Examiner is not persuaded by Applicant's argument that Lucas "does not disclose or provide an indication of the quality of the channel". As detailed above in the section providing arguments against the rejection of claim 1, Applicant submits that Lucas discloses a correlator 33 in the search arm 30 that is used in determining if the estimated delay D is a better estimate than the values of delay D1 and D2 used in reception arms 10 and 20. The output of the correlator 33 is used to generate a reception energy E and this is compared to the reception energies E1 and E2 of reception arms 10 and 20. If E is greater than E1 or E2, the value of D replaces either D1 or D2 to ensure that "delays added to the reception arms 10,20 correspond to paths for which the propagation conditions are best" (col. 5, lines 55-57 of Lucas). For at least the reasons discussed above, Applicant submits that what is disclosed in Lucas is different than what is recited in claims 1, 4, 7, 11 and 14.

In addition, for the reasons presented above that Lucas teaches away from providing any type of feedback signal to a transmitter, especially the type output from the correlator of Lucas, as recited in claims 1, 11 and 14, Applicant submits that there are differences between Lucas and at least claims 1, 11 and 14 and there is a lack of a suitable reason for combining the references cited in the manner set forth by the Examiner to arrive at the claimed invention.

In defending the position that the relevance of the use of ten Brink is clear, the Examiner states on page 3 of the Final Office Action that "when a work (is available) in a field of endeavour, design incentives and other factors can prompt variations of it, either in the same field or a different one and if a person of ordinary skill can implement a predictable variation, 103 likely bars its patentability. As per Applicant's remarks (page 18-19) regarding motivation to combine, it is reminded to the Applicant that the strongest rationale for combining references is a recognition, expressly or implied in the prior art or drawn from a convincing line or reasoning based on established scientific principles or legal precedent, that some advantage or expected benefit would have been produced by there combination". Applicant maintains that the Examiner has failed to show a convincing line of reasoning. The Examiner states that the middle of page 3 that ten Brink, Stein and Lucas disclose "the advantage for such combination by disclosing the concept of correlation to produce a channel response quality indicator imposed at

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the site of the transmitter to produce synchronized sequence for a spreading sequence". Applicant respectfully submits that this is not totally correct as none of the references disclose feeding back a channel quality indicator to a transmitter. The Examiner has cited Balachandran as disclosing this limitation. However, even if Balachandran was included in this group of references, Applicant submits that the advantage suggested by the Examiner "to produce a synchronized sequence for a spreading response" is not what is claimed in the present invention and there is no indication that one would arrive at the claimed invention if the references were combined to provided a result with the advantage identified by the Examiner.

Conclusions

With respect to each of the issues presented herein for review, Applicant respectfully submits that errors have been made in the rejection of the appealed claims.

Regarding the issue of whether claims 1, 4, 7, 11 and 14 are unpatentable under 35 U.S.C. 103(a) over ten Brink (US Patent 6,611,513) in view of Stein (USP 6,175,590) and Lucas (USP 5,488,600) and further in view of Balachandran (USP 6,215,827), Applicant respectfully requests that the rejection of these claims be reconsidered by the Board and withdrawn.

Regarding the issue of whether claims 2, 3, 5, 6, 12, 13, 15 and 16 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas and in view of Balachandran and further in view of Jones (USP 6,215,813), Applicant respectfully requests that the rejection of these claims be reconsidered by the Board and withdrawn.
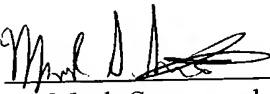
Regarding the issue of whether claims 8 to 10 are unpatentable under 35 U.S.C. 103(a) over ten Brink in view of Stein, Lucas, Balachandran and further in view of Thomas (US Patent Publication No. 2002/0051498), Applicant respectfully requests that the rejection of these claims be reconsidered by the Board and withdrawn.

Regarding the issue of whether claim 36 is unpatentable under 35 U.S.C. 103(a) over Agee (USP 6,621,851) in view of Tiedemann (US Publication 2006/0094460), Applicant respectfully requests that the rejection of these claims be reconsidered by the Board and withdrawn.

Regarding the issue of whether claims 40 and 41 are anticipated under 35 U.S.C. 102(e) by Walton (US publication 2006/0105761), Applicant respectfully requests that the rejection of these claims be reconsidered by the Board and withdrawn.

Respectfully submitted,

MING JIA

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Date: October 3, 2008

MSS:mcg

Claims Appendix

1. (Previously presented)   A channel quality measurement apparatus adapted to measure a quality of a channel over which has been transmitted a sequence of symbols produced by encoding and constellation mapping a source data element sequence, the apparatus comprising:

a symbol de-mapper, receiving as input a sequence of received symbols over the channel whose quality is to be measured, said symbol de-mapper being adapted to perform symbol de-mapping on said sequence of received symbols to produce a sequence of soft data element decisions;

a soft decoder, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, said soft decoder being adapted to decode the sequence of soft data element decisions to produce a decoded output sequence;

an encoder, receiving as input the decoded output sequence produced by the soft decoder, said encoder being adapted to re-encode the decoded output sequence with an identical code to a code used in encoding the source data element sequence to produce a re-encoded output sequence;

a correlator, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, and the re-encoded output sequence produced by the encoder, said correlator being adapted to produce a channel quality indicator output by determining a correlation between the sequence of soft data element decisions and the re-encoded output sequence;

wherein the apparatus is adapted to feed the channel quality indicator back to a transmitter for use in determining and applying an appropriate coding rate and modulation to the source data element sequence.

2. (Original)   A channel quality measurement apparatus according to claim 1 wherein the symbol de-mapper is adapted to perform QPSK symbol de-mapping.

3. (Original)   A channel quality measurement apparatus according to claim 1 wherein the symbol de-mapper is adapted to perform Euclidean distance conditional LLR symbol de-mapping.

4. (Previously presented)   A method of measuring channel quality of a channel over which has been transmitted a sequence of symbols produced by encoding and constellation mapping a source data element sequence, the method comprising:

receiving a sequence of received symbols over the channel whose quality is to be measured;

symbol de-mapping said sequence of received symbols to produce a sequence of soft data element decisions;

decoding said sequence of soft data element decisions to produce a decoded output sequence;

re-encoding said decoded output sequence to produce a re-encoded output sequence using a code identical to a code used in encoding the source data element sequence; and

correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output.

5. (Original)   A method of channel quality measurement according to claim 4 wherein the symbol de-mapping of said sequence of received symbols is QPSK symbol de-mapping.

6. (Original)   A method of channel quality measurement according to claim 4 wherein the symbol de-mapping of said sequence of received symbols comprises Euclidean distance conditional LLR de-mapping.

7. (Previously presented)   A method of measuring OFDM channel quality of an OFDM channel over which has been transmitted a sequence of OFDM symbols, the OFDM symbols containing an encoded and constellation mapped source data element sequence, the method comprising:

receiving a sequence of OFDM symbols over the OFDM channel whose quality is to be measured;

symbol de-mapping said sequence of received symbols to produce a sequence of soft data element decisions;

decoding said sequence of soft data element decisions to produce a decoded output sequence pertaining to the source data element sequence;

re-encoding said decoded output sequence to produce a re-encoded output sequence using a code identical to a code used in encoding the source data element sequence; and

correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output.

8. (Original)   A method of OFDM channel quality measurement according to claim 7 wherein the symbol de-mapping of said sequence of received symbols is QPSK symbol de-mapping.

9. (Original)   A method of OFDM channel quality measurement according to claim 7 wherein the symbol de-mapping of said sequence of received symbols comprises Euclidean distance conditional LLR de-mapping.

10. (Original)   A method of OFDM channel quality measurement according to claim 7 wherein the decoding of said sequence of soft data element decisions to produce a decoded output sequence further comprises using a history of the soft data element decisions, and using information about encoding of the sequence of symbols transmitted over the channel.

11. (Previously Presented)   A communication system comprising:

a transmitter adapted to transmit a sequence of symbols produced by encoding and constellation mapping a source data element sequence over a channel; and

a receiver comprising:

a) a symbol de-mapper, receiving as input a sequence of received symbols over the channel, said symbol de-mapper being adapted to perform symbol de-mapping on said sequence of received symbols to produce a sequence of soft data element decisions;

b) a soft decoder, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, said soft decoder being adapted to decode the sequence of soft data element decisions to produce a decoded output sequence;

c) an encoder, receiving as input the decoded output sequence produced by the soft decoder, said encoder being adapted to re-encode the decoded output sequence with an identical code to a code used in encoding the source data element sequence to produce a re-encoded output sequence; and

d) a correlator, receiving as input the sequence of soft data element decisions produced by the symbol de-mapper, and the re-encoded output sequence produced by the encoder, said correlator being adapted to produce a channel quality indicator output by determining a correlation between the sequence of soft data element decisions and the re-encoded output sequence,

wherein the receiver is adapted to feed the channel quality indicator back to the transmitter, and wherein the transmitter is adapted to use said channel quality indicator to determine and apply an appropriate coding rate and modulation to the source data element sequence.

12. (Original)   A communication system according to claim 11 wherein the symbol de-mapper is adapted to perform QPSK symbol de-mapping.

13. (Original)   A communication system according to claim 11 wherein the symbol de-mapper is adapted to perform Euclidean distance conditional LLR symbol de-mapping.

14. (Original)   A method of adaptive modulation and coding comprising:

transmitting over a channel a sequence of symbols produced by encoding and constellation mapping a source data element sequence;

receiving a sequence of received symbols over the channel;

symbol de-mapping said sequence of received symbols to produce a sequence of soft data element decisions;

decoding said sequence of soft data element decisions to produce a decoded output sequence;

re-encoding said decoded output sequence to produce a re-encoded output sequence using a code identical to a code used in encoding the source data element sequence;

correlating said re-encoded output sequence, and said sequence of soft data element decisions to produce a channel quality indicator output;

transmitting the channel quality indicator; and

using said channel quality indicator to determine and apply an appropriate coding rate and modulation to the source data element sequence.

15. (Original) A method of adaptive modulation and coding according to claim 14 wherein the symbol de-mapping of said sequence of received symbols is QPSK symbol de-mapping.

16. (Original) A method of adaptive modulation and coding according to claim 14 wherein the symbol de-mapping of said sequence of received symbols comprises Euclidean distance conditional LLR de-mapping.

17. (Cancelled)

18. (Original) A method comprising:

applying forward error coding to a signalling message to generate a coded fast signalling message;

MPSK mapping the coded signalling message to produce an MPSK mapped coded signalling message;

mapping the MPSK mapped coded signalling message onto a plurality of sub-carriers within an OFDM frame comprising a plurality of OFDM symbols;

encoding symbols of the MPSK mapped coded signalling message using Differential Space-Time Block Coding (D-STBC) in a time direction to generate encoded symbols; and

transmitting the encoded symbols on a plurality of transmit antennas, with the encoded symbols being transmitted at an increased power level relative to other symbols within the OFDM frame as a function of channel conditions.

19. (Original) A method according to claim 18 wherein the encoded symbols is transmitted in a scattered pattern.

20. (Original) A method according to claim 18 wherein transmitting the encoded symbols on a plurality of antennas comprises:

on a selected sub-carrier, each antenna transmitting a respective plurality N of encoded symbols over N consecutive OFDM symbols, where N is the number of antennas used to transmit, for a total of NxN transmitted encoded symbols, the NxN symbols being obtained from D-STBC encoding L symbols of the MPSK mapped coded signalling stream, where L,N determine an STBC code rate.

21. (Original) A method according to claim 20 further comprising:

transmitting a set of pilot sub-carriers in at least one OFDM symbol;

using the pilot sub-carriers as a reference for a first set of D-STBC encoded symbols transmitted during subsequent OFDM symbols.

22. (Original) A method according to claim 21 wherein transmitting a set of pilot sub-carriers in at least one OFDM frame comprises:

transmitting a plurality of pilots on each antenna on a respective disjoint plurality of sub-carriers.

23. (Original) A method according to claim 22 wherein each disjoint plurality of sub-carriers comprises a set of sub-carriers each separated by N-1 sub-carriers, where N is the number of antennas.

24. (Original) A method according to claim 22 wherein pilot sub-carriers are transmitted for a number of consecutive OFDM frames equal to the number of transmit antennas.

25. (Original) A method according to claim 18 wherein the signalling message contains an identification of one or more receivers who are to receive data during a current TPS frame.

26 (Original) An OFDM transmitter adapted to implement a method according to claim 18.

27. (Original) An OFDM transmitter adapted to implement a method according to claim 20.

28. (Previously Presented) A receiving method for an OFDM receiver comprising:

receiving on at least one antenna an OFDM signal containing received D-STBC coded MPSK mapped coded signalling message symbols;

recovering received signalling message symbols from the OFDM signal(s);

determining from the signalling message symbols whether a current OFDM transmission contains data to be recovered by the receiver;

upon determining the current OFDM transmission contains data to be recovered by the receiver:

a) re-encoding, MPSK mapping and D-STBC coding the received coded signalling message symbols to produce re-encoded D-STBC coded MPSK mapped coded signalling message symbols;

b) determining a channel estimate by comparing the received D-STBC coded mapped coded signalling message symbols with the re-encoded D-STBC coded MPSK mapped coded signalling message symbols.

29. (Original)   A method according to claim 28 wherein a channel estimate is determined for each location (in time, frequency) in the OFDM signal containing D-STBC coded MPSK mapped coded signalling message symbols, the method further comprising interpolating to get a channel estimate for remaining each location (in time, frequency) in the OFDM signal.

30. (Original)   A method according to claim 29 further comprising:

receiving pilot symbols which are not D-STBC encoded which are used as a reference for a first D-STBC block of D-STBC coded MPSK mapped coded signalling message symbols.

31. (Original)   A method according to claim 28 further comprising:

extracting the signalling message.

32. (Original)   An OFDM receiver adapted to implement the method of claim 28.

33. (Cancelled)

34. (Original)   An article of manufacture comprising a computer-readable storage medium, the computer-readable storage medium including instructions for implementing the method of claim 18.

35. (Original)   An article of manufacture comprising a computer-readable storage medium, the computer-readable storage medium including instructions for implementing the method of claim 28.

36. (Previously presented)   A method of determining a channel response from an Orthogonal Frequency Division Multiplexing (OFDM) frame received at an OFDM receiver, the OFDM frame containing an encoded fast signalling message in the form of encoded symbols within the OFDM frame, the method comprising the steps of:

processing the encoded symbols based on a scattered pilot pattern to recover the encoded fast signalling message as a recovered encoded fast signalling message;

re-encoding the recovered fast signalling message so as to produce known pilot symbols in the scattered pilot pattern;

determining a channel response for the encoded symbols using decision feedback.

37. (Previously presented)   The method of claim 36 comprising the further step of applying a fast algorithm to compute a Discrete Fourier Transform based on the scattered pilot pattern to extract the combined pilot symbols and fast signalling message and only proceeding to recover the channel response if the fast signalling message indicates a current transmission contains content for the OFDM receiver.

38. (Previously presented)   The method of claim 36 wherein processing the encoded symbols comprises:

differentially decoding the encoded symbols using Differential Space-Time Block Coding (D-STBC) decoding to recover the encoded fast signalling message;

applying Forward Error Correction decoding to the encoded fast signalling message to recover a fast signalling message;

analyzing the fast signalling message to determine whether it includes a desired user identification;

if the fast signalling message includes the desired user identification, re-encoding the recovered fast signalling message comprises:

re-encoding the fast signalling message using Forward Error Correction coding to generate the encoded fast signalling message, and re-encoding the encoded fast signalling message using D-STBC.

39. (Cancelled)

40. (Previously presented)   A transmitter adapted to combine pilot and transmission parameter signalling on a single overhead channel within an OFDM signal, the transmitter comprising:

an encoder;

at least one transmit antenna;

wherein a set of transmission parameter signalling symbols are transmitted by the at least one transmit antenna on the overhead channel with strong encoding performed by the encoder such that at a receiver, they can be decoded accurately, re-encoded, and the re-encoded symbols treated as known pilot symbols which can then be used for channel estimation.

41. (Previously presented) A receiver adapted to process the combined single overhead channel produced by the transmitter of claim 40, the receiver comprising:

at least one receive antenna;

a soft decoder;

an encoder;

the receiver being adapted to:

utilize the soft decoder to decode a received signal from the at least one receive antenna containing the encoded transmission parameter signalling symbols as modified by a channel;

utilize the encoder to re-encode the decoded symbols to produce known pilot symbols; and

compare received symbols with the known pilot symbols to produce a channel estimate.

Evidence Appendix

None

Related Proceedings Appendix

None